



# ***Naval Aviation Crew Resource Management (CRM) Initiative***

Human Factors QMB/Training Improvements  
Working Group Brief

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**COMSEACONWINGPAC**

26 July 00



# *Crew Resource Management (CRM) Initiative*

- **Naval Air Board Human Factors ESC**
  - **Naval Air Board Human Factors QMB**
    - **Training Improvements Working Group**
      - Initiatives to reduce skill-based and judgment errors:
        - **CADS Beta Test** (standardized data collection, crew feedback, and performance measurement)
        - **Integrated CRM** event-based curriculum (emphasis on situational awareness/decision making)
        - **Advanced Flight Instructor skills** (performance assessment/coaching)
        - **Decision Skills Training** (emphasis on critical thinking)

# CRM Goals

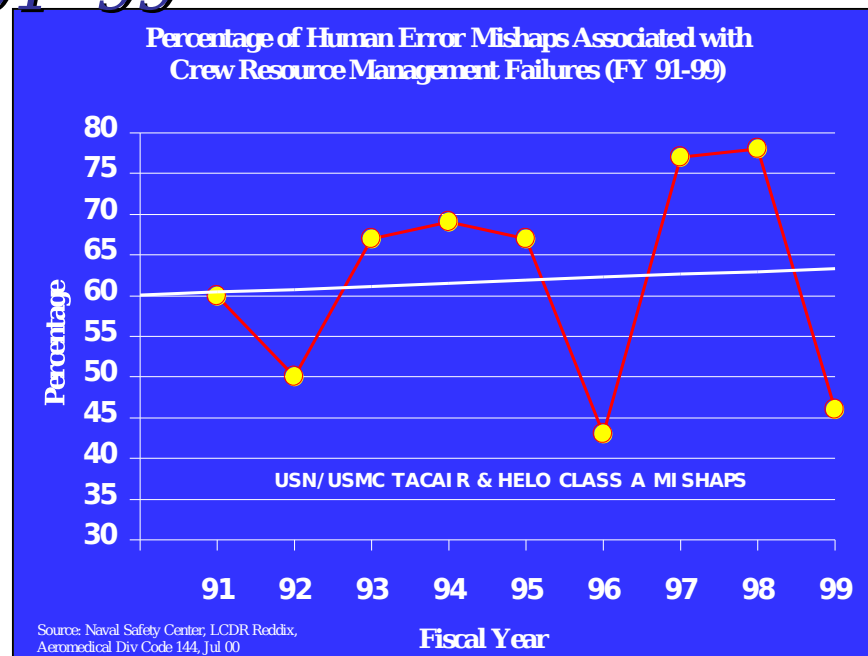
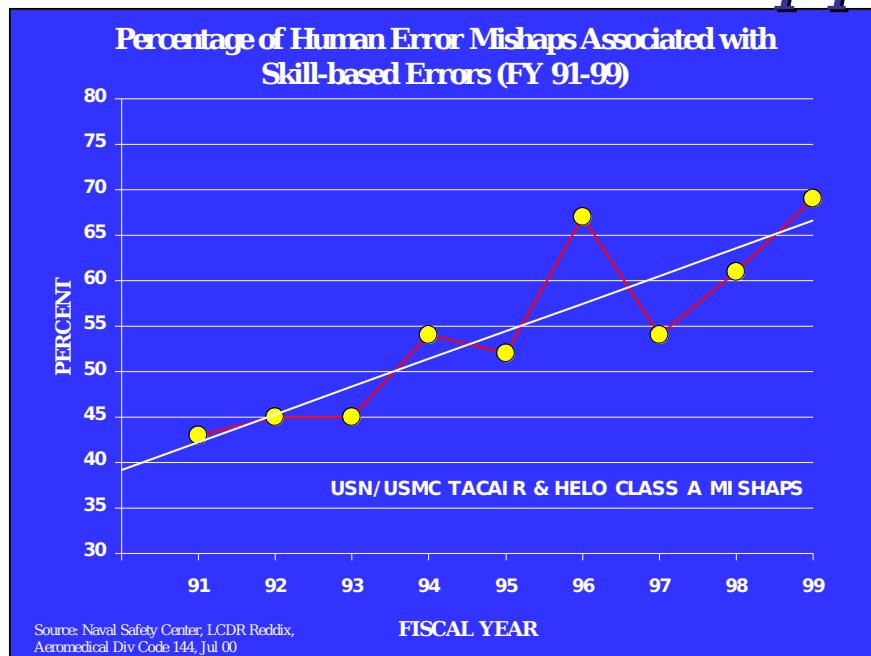
- Reduce mishap rate caused by HF & skill-based errors:
  - Provide aircrews with more realistic, defined training experiences and standards
  - Standardized procedures
- Improve mission performance:
  - Measurable evaluation and improved feedback adapted to each type model aircraft across Air Combat Training Continuum
  - Validate and improve effectiveness of Training and Readiness Matrices

\* CRM = Crew Resource Management

# Skill-based & CRM Errors

## Naval Aviation Mishaps

*FY 91-99*



# CRM Elements

- CRM Elements
  - Operational Risk Assessment & Management
  - Aircraft Flight Control
  - Communication Skills
  - Decision Processes & Skills
  - Situational Awareness
  - Tactical and Standard Operating Procedures
- Integrated CRM elements vice stove-  
pipied:
  - NATOPS procedures and checklists
  - Training curriculum and evaluation

\* CRM = Crew Resource Management

# FAA ACRM Training

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## **Developing Advanced Crew Resource Management (ACRM) Training: A Training Manual**

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Thomas L. Seamster, Deborah A. Boehm-Davis, Robert W. Holt, and Kim Schultz

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August 1, 1998



Federal Aviation Administration  
Office of the Chief Scientific and  
Technical Advisor for Human  
Factors, AAR-100

# CRM Initiative

A diagram illustrating the CRM Initiative. At the top is a light blue rectangular header with the text "CRM Initiative" in bold blue font. Below this header are three vertical, light blue cylindrical pillars. Each pillar is supported by a light blue rectangular base. The bases contain text in bold blue font. The left base reads "Computer Aided Performance Assessment System and Analysis". The middle base reads "NATOPS and Tactical Integration/ Instructional Systems Design". The right base reads "Instructor Training and Decision Skills Training". All three bases sit on a single, wide light blue rectangular footer that contains the text "CHAIN OF COMMAND SUPPORT" in bold blue font.

**Computer  
Aided  
Performance  
Assessment  
System  
and  
Analysis**

**NATOPS  
and  
Tactical  
Integration/  
Instructional  
Systems  
Design**

**Instructor  
Training  
and  
Decision  
Skills  
Training**

**CHAIN OF COMMAND  
SUPPORT**

# CADS™

- **CADS™ Registered trademark of ER Labs for commercial digital playback system in simulators:**

- COTS technology - digital recording, storage, playback of flight & tactics (VS)
- Beta system at VS-41 (FRS) since 1997
- HSL-41 (FRS) system installed 1998
- Airline beta tests (Northwest, Delta)
- Navy Installs in work (simulators):
  - HSL-40 (Mayport)
  - COMSEACONWINGLANT    VAQ 139 (FRS)



# CAPAS/CADS™

## **CAPAS - Computer-Aided Performance Assessment System (Navy version)**

- Mission Need Statement - CNO approved (May 99)
- Operational Requirements Document (ORD)
  - CINCPACFLT endorsed to NAVAIR (Mar 00)
- **Required Capability (Simulator):**
  - Record audio, video & data (flight & tactics)
  - Debrief & evaluation (subjective & objective)
  - Analysis (immediate and long term) (objective)
  - Archive & edit
- ***Potential for aircraft use***

# CAPAS/CADS™ Current Capability

- **Digitally records entire simulator event:**
  - Cockpit, aircraft, flight & tactics (VS) performance data
  - Crew audio and video
  - Aircraft aspect and tactical plot
- **Instructor digitally ‘marks’ places while recording event using Interface Device**
  - Can return instantly to digital marks during debrief, improving fidelity and focus of debriefs
  - Marks become reference for later analysis of CRM performance

\* CAPAS = Computer-Aided Performance Assessment

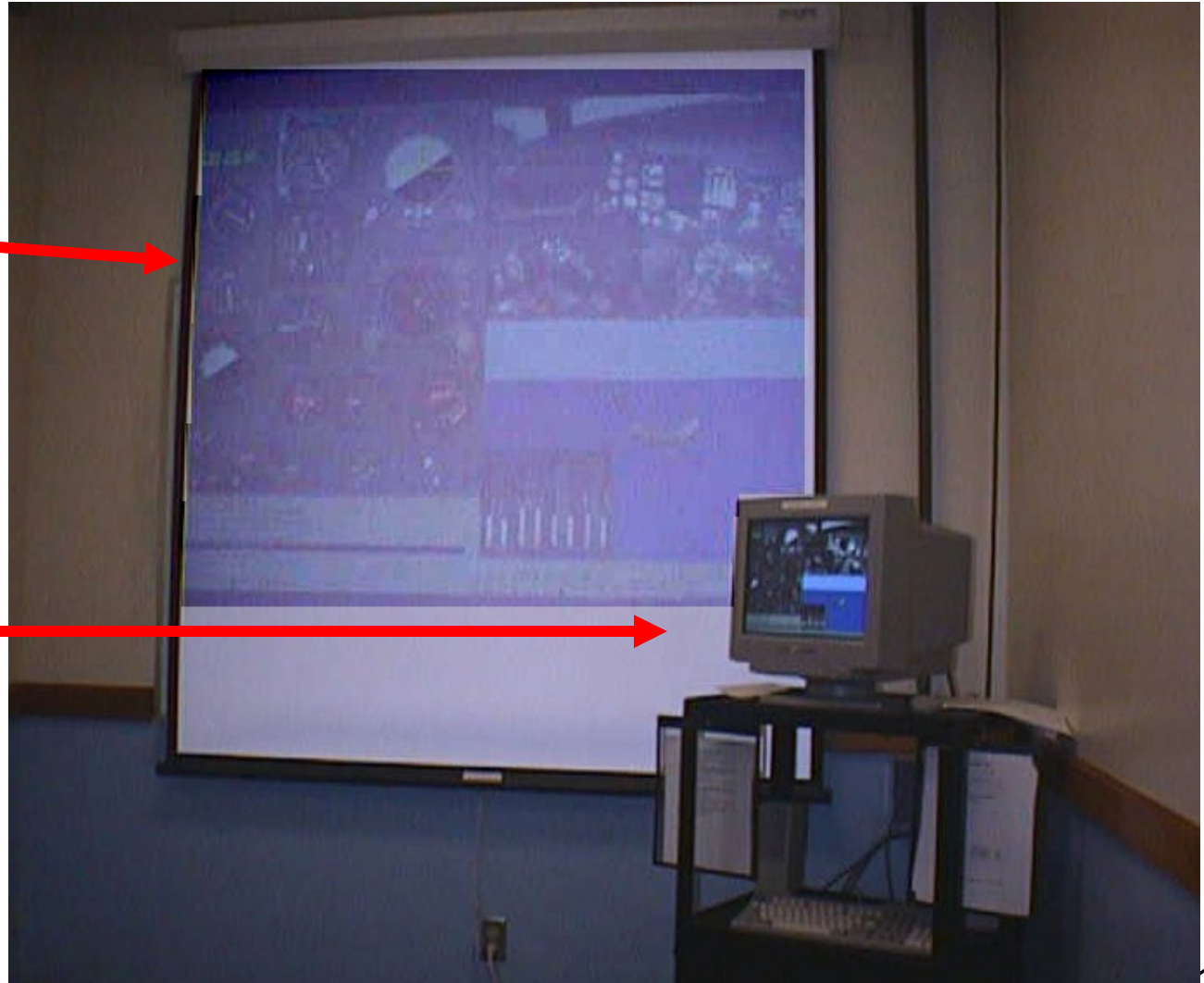
# VS-41 Debrief Room

## CAPAS/CADS™

**Big screen  
display**



**Monitor & PC**



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# Sample CAPAS/CADS™ Display

Cockpit  
Instruments

IR  
Cockpit  
Video  
Pilot

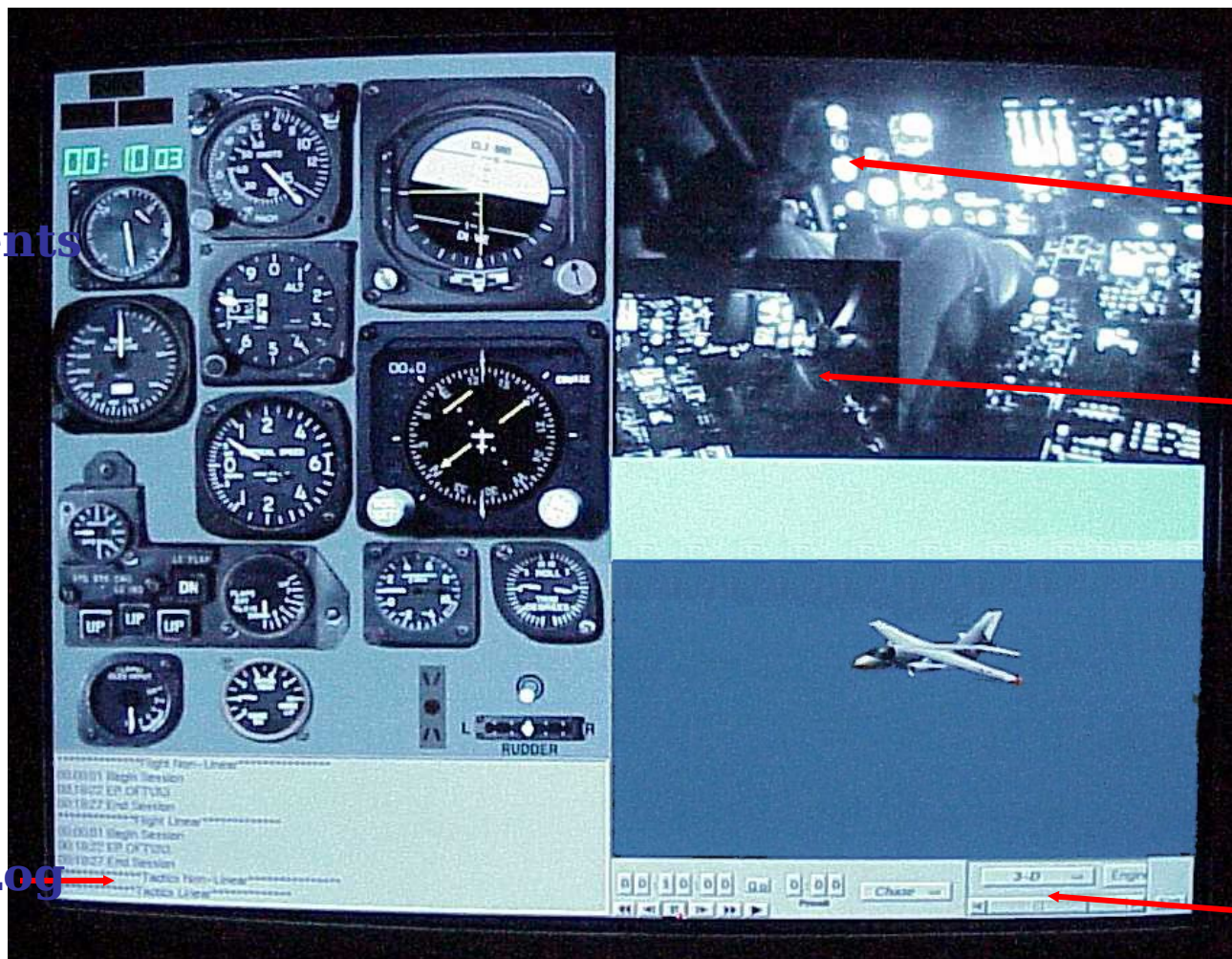
COTAC

## Views

- Chase plane
- Tower
- LSO
- Tactical plot

Replay  
controls

Marker Log



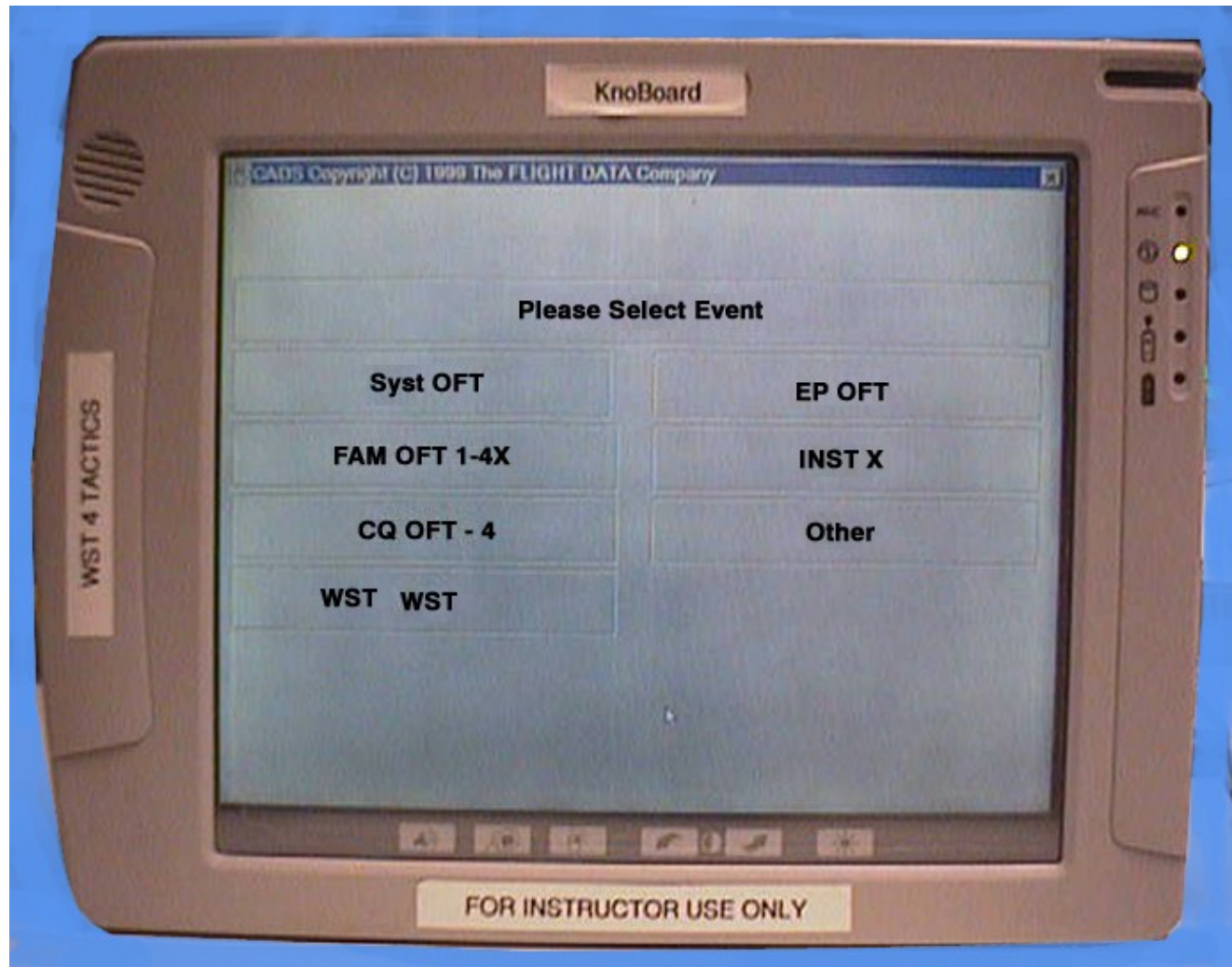
\* CAPAS = Computer-Aided Performance Assessment

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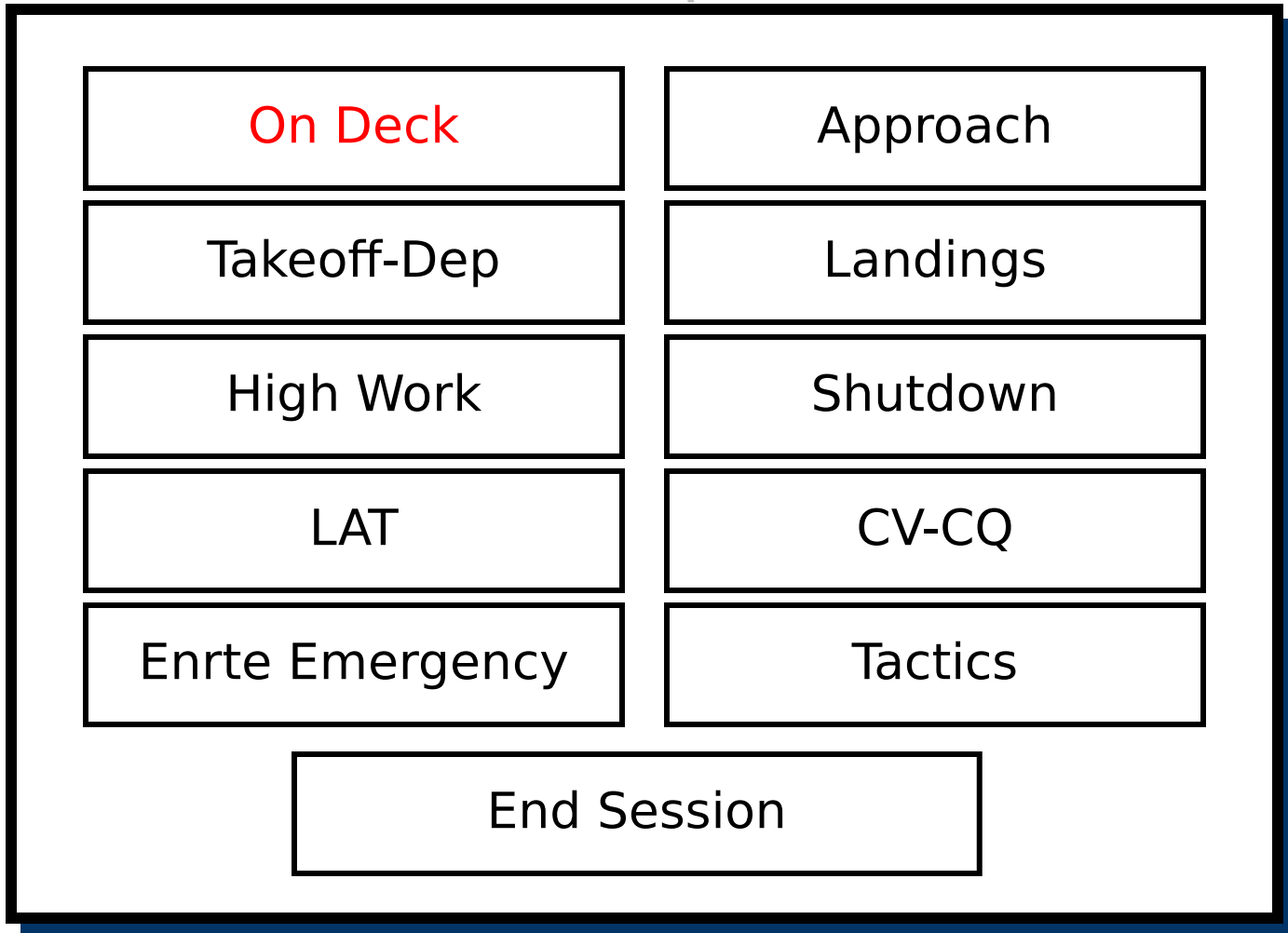


# CAPAS/CADS™ Interface Device Example

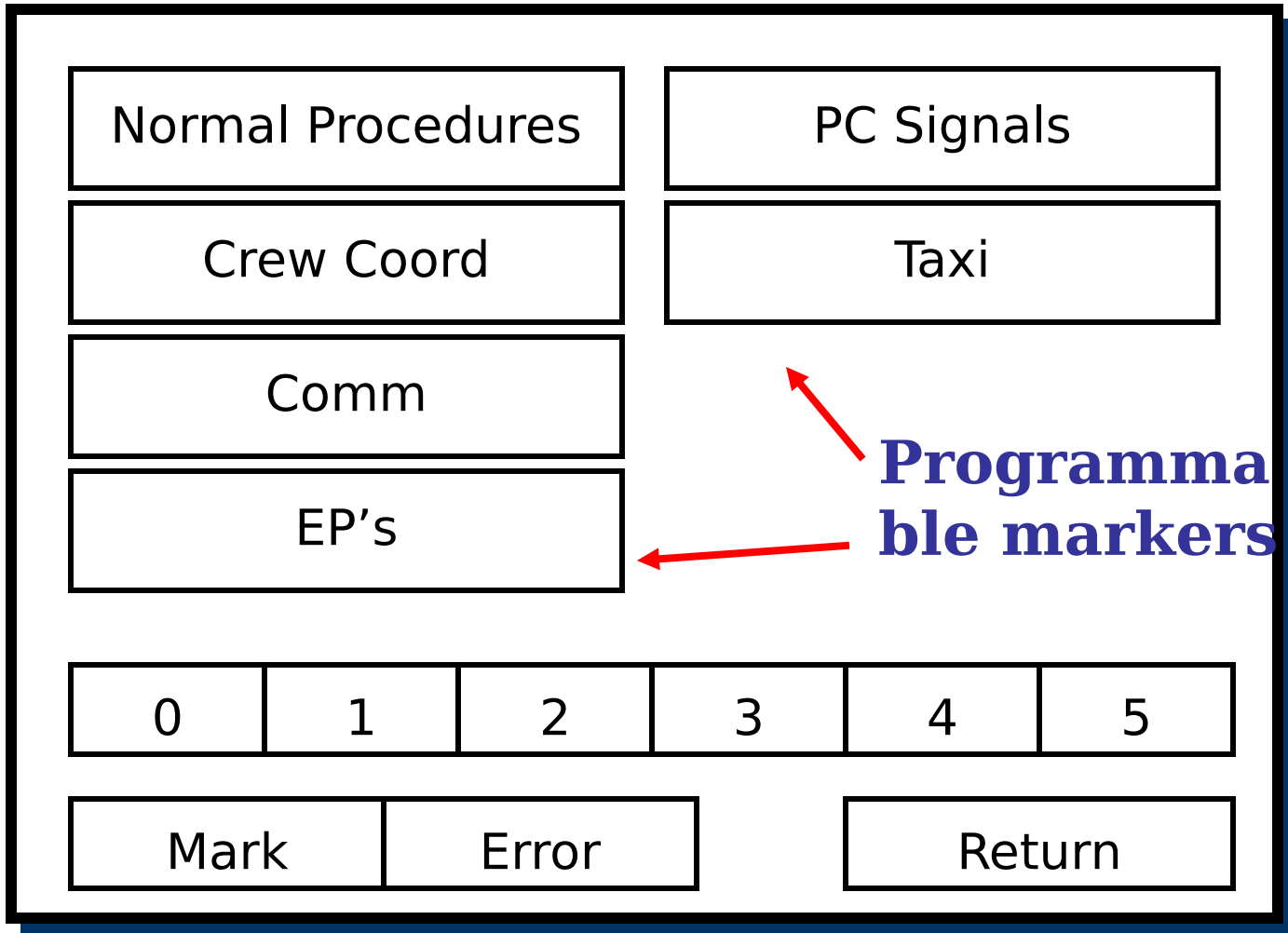
- Hand held or Mounted
- Programmable



# CAPAS/CADS™ Interface Device Example



# Marks within 'On Deck'



# CAPAS Usage at VS-41

- **Used to assist assessment and feedback for 18 of 29 simulator events (62%):**
  - 4 Weapon System Trainers (WST)
  - 9 Operational Flight Trainers (OFT/CQOFT)
  - 5 Tactics and Ordnance Trainers
- **System utility varies significantly with event type**
  - Most useful on CRM-intensive WST and OFT events
  - Not as useful on flight/weapon procedural trainers
- **Beyond the debrief**
  - Instructor training & standardization (“SOD/down” review)
  - Establishing an event file library for student review



# CAPAS Instructor Training at VS-41

- **6+ hours of CAPAS training for IUT's**
  - Human performance (2.5 hr)
  - Debriefing and Grading (3 hrs)
  - CAPAS operation/hands on application (.5 - 1 hr)
- **Recurrent Training Usage - CADS files**
  - Instructor standardization
  - Debrief/analysis of SODs (“downs”) and “gold standards”
  - “What if?” scenarios
  - *Even mundane events will provoke 10-15 min of discussion*

# Planned CAPAS/CADS™ Upgrades

- Next Steps

- Incorporate **video crew de-identification** software
- Install Windows-based drag and drop editing capability (**IT-21 compliant**).
- Add capability to **save edited files to CD-ROM/DVD** for use in classroom and stand-alone Computer-Based Training (CBT)
- *Begin routine flight skill and CRM performance **data collection and analysis.***

# CAPAS Benefits

- **Student**

- Focused debrief - immediate access to marked learning points
- Details facilitate self-assessment
- Identify and correct deficient skills at earliest point; create individual performance plans
- Access to archive of best/worst aircrew practices (de-identified)

- **Instructor**

- Improved instructor performance
  - Improved standardization
    - Specific evaluation criteria established and used
    - Ensure event objectives covered
    - Evaluate inter-rater reliability in grading
  - Improved use of debrief time
- Establish and archive best instructional practices (de-identified)

# CAPAS Benefits

- **Curriculum**

- Track both individual and group training trends
- Establish/change evaluation & performance standards
- Enhances student/instructor focus on specific knowledge/skill/judgement
  - Identify and eliminate unnecessary objectives
  - More accurate identification of deficiencies
- Incorporate best practices event files throughout curriculum (CBT, instructor training)

# Data Collection and Assessment

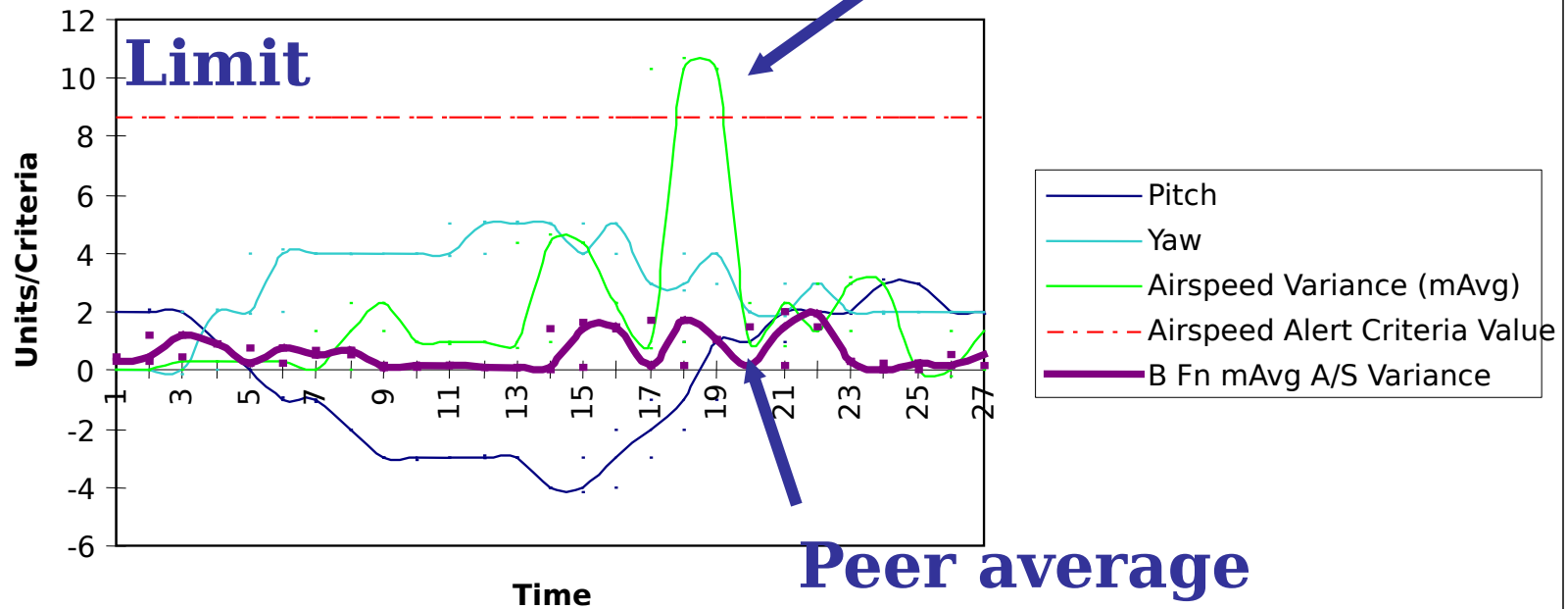
- **Map skill performance against:**
  - Established standards
  - Performance of peers
  - Previous performance (self)

**Analyze training and ops data instead of mishap data**

# CAPAS Analysis Single Event

Airspeed

Sample Data Management Student



# Performance Analysis

## ***Learning Curve***

***Altitude Management***

**Pilot's 1st attempt**  
**Pilot's 2nd attempt**

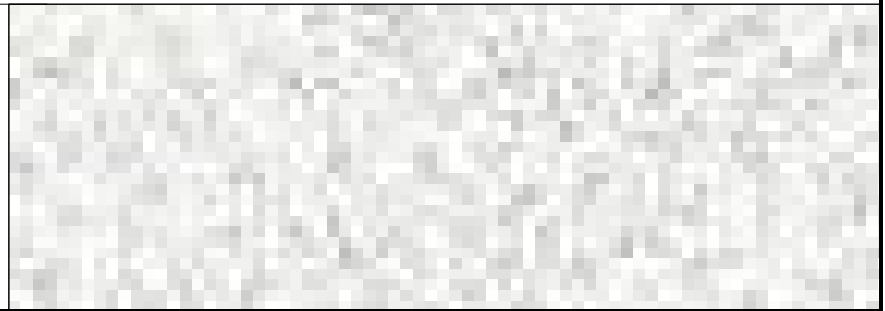
**a**

**Pilot's average** **b**

**400**

SAMPLE DATA

SAMPLE DATA



# Data Collection, Assessment & Analysis

- **Aircrews, Instructors, & Training System**

- Provide real-time detailed feedback to aircrews, instructors & training systems
- Objective evaluation
- Diagnose and predict performance
  - Identify behaviors/skill levels that consistently lead to successful mission performance
- Identify rate of skill degradation
- Define underlying/systemic problems that lead to mishaps

- **Analyze training and ops data instead of mishap data**



# ACTC Measurement/Feedback

- **Identify behaviors and skill levels that lead to consistent, successful performance**
- **Identify skill degradation rates**
  - Provides objective measurement for T & R Matrix (periodicity)
- **Map skill development and proficiency to establish objective performance standards**
- **Provide real-time, detailed feedback to aircrews, instructors & training system**

\*ACTC = Aviation Combat Training Continuum

# NATOPS & SOP

- **Will benefit from data gained through current CRM program initiatives:**
  - Identify best crew behaviors/problem areas to:
    - Better define and organize critical elements of NATOPS & SOPs
  - Improved Flight Manuals and Pocket Checklists
    - Human Factors format to reduce crew errors

# NATOPS Examples

## Current version

### OIL SYSTEM MALFUNCTIONS

- \*1. Throttle.....Idle; Monitor  
Engine Instruments

*If abnormal indications persist:*

- \*2. Throttle.....OFF  
\*3. FIRE pull handle.....Pull  
\*4. Ignition switch.....OFF  
5. Generator switch.....OFF  
6. APU.....Check Altitude,  
Airspeed/Start  
7. APU automatic shutdown.....Disarm  
8. APU GEN switch.....ON  
9. BLEED AIR switch.....OFF  
10. Hydraulic servo (if No. 2).....OFF  
11. Land as soon as practicable.....Refer to  
Single-Engine  
Landing Procedure

#### WARNING

If the oil pressure drops to zero, the engine shall be shut down to preclude a catastrophic failure, unless safety of flight dictates otherwise.

## Proposed new version

### OIL SYSTEM MALFUNCTION

- \*1. THROTTLE  
2. ENGINE INSTRUMENTS  
- IDLE  
- MONITOR

#### WARNING

If the oil pressure drops to zero, the engine shall be shut down to preclude a catastrophic failure, unless safety of flight dictates otherwise.

*IF ABNORMAL INDICATIONS PERSIST:*

3. THROTTLE  
4. PRECEED TO NEAREST SUITABLE FIELD FOR LANDING  
5. IMMEDIATE ACTIONS COMPLETE,  
GO TO ENGINE FAILURE / FIRE / EXPLOSION SHUTDOWN  
CHECKLIST PAGE [18]

# NATOPS Example

*Proposed new NATOPS  
procedures that follow-on from  
those in the new **OIL  
PRESSURE MALFUNCTION**  
procedure:*

## ENGINE FAILURE FOLLOW-ON PROCEDURES / APPROACH AND LANDING CHECKLISTS

### **ENGINE FAILURE / FIRE / EXPLOSION SHUTDOWN CHECKLIST**

- IF ENGINE FAILURE WAS NOT CAUSED BY A MECHANICAL MALFUNCTION OR A GREATER EMERGENCY EXISTS:
- OR**
- BEFORE AIRSTART / ASSISTED AIRSTART  
Checklist...PERFORM GO TO PAGE [40]**
- IF ENGINE RESTART WILL NOT BE ATTEMPTED OR ENGINE DOES NOT START:
1. EHP - ON
  2. APU - CHECK
  3. APU AUTOMATIC SHUTDOWN ALTITUDE / AIRSPEED / START - DISARM
  4. APU GEN SWITCH - ON
  5. \_\_\_ GENERATOR SWITCH - OFF
  6. \_\_\_ BLEED SWITCH - OFF
  7. \_\_\_ IGNITION SWITCH - OFF
  8. \_\_\_ HYDRAULIC SERVO (IF #2 ENGINE) - OFF
  9. LAND AS SOON AS PRACTICABLE
- OR**
- IF #1 HYDRAULIC SYSTEM IS OPERABLE:
10. CHECKLIST COMPLETE,  
GO TO **SINGLE ENGINE APPROACH AND LANDING  
CHECKLIST PAGE [45]**
- IF #1 HYDRAULIC SYSTEM INOPERABLE:
11. HYDRAULIC SERVO #1 - OFF
  12. CHECKLIST COMPLETE,  
GO TO **SINGLE ENGINE/ #1 HYDRAULIC SYSTEM INOPERABLE  
APPROACH AND LANDING CHECKLIST PAGE [46]**

# Advanced Curriculum Support

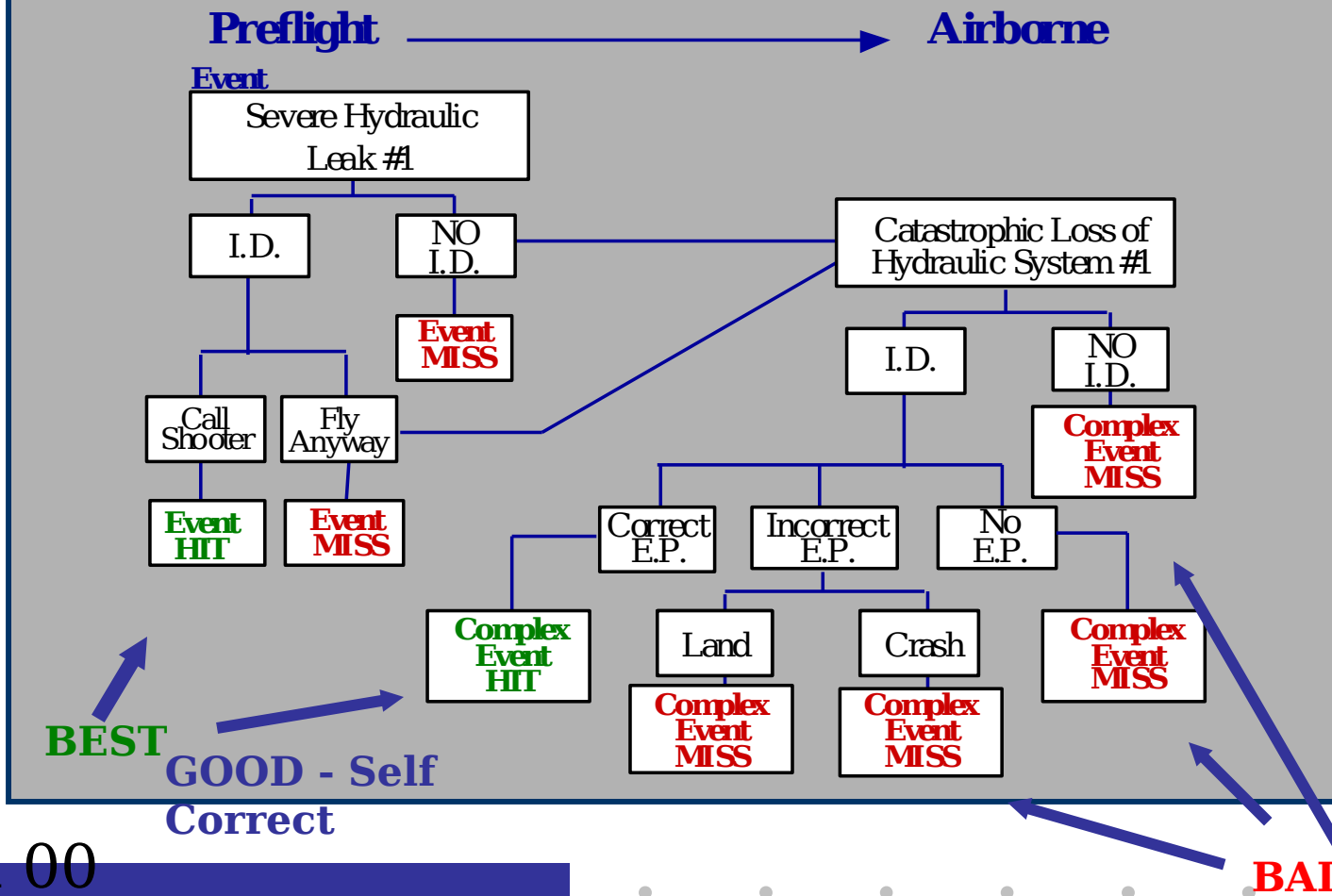
- **Advanced training concepts: instructional techniques and technology**
  - **Human Factors** & performance emphasis
  - **Cognitive & Skill Task analysis:**
    - CAPAS to capture task/mission analysis
    - Interviews to capture experiences & thought processes
  - Integrate **SA and Decision Making** experiences throughout curriculum
    - Lectures, CBT, brief, debrief, evaluations
  - Design curriculum for systematic data collection

# Scenario Design/Development

- **Assess skills for effective flight performance and priority of decisions**
  - Address mishap/HAZREP causal factors, tactical and flight performance
  - Create models that correlate crew processes (MOP) to best performance (MOE).
  - Trigger performance against a measurable standard
  - Flight precision skill (stick and rudder)
  - Decision skills (ORM/CRM, NATOPS procedures, SOP, tactical procedures)

# Event-Based Scenario

## Scenario Decision Tree



# Flight Instructor Training

- **Five-day course with practical application**
  - Instructor Team (Ed Spec, CSI, Stan, Curriculum)
  - Human factors integration
  - Instructional techniques & standardization
  - Scenario development
  - Crew evaluation and feedback
  - Decision skills facilitation
- **Assessing Human Performance**
- **Use CAPAS recordings (best & worst)**
  - Practice evaluating instructional techniques and grading events



# Flight Instructor Training

- **Ongoing instructor performance data collection and feedback:**
  - Training objectives covered? (Time/quality)
  - Grading criteria used specific to event?
  - Quality of instruction, evaluation and crew performance feedback

# Aviator SA/Decision Skills Training

- ***Adaptive Decision Making*** in uncertain, time-constrained situations
- Focuses instructors & crews on critical thinking and problem solving
- Developing plans *and* solutions to realistic situations
- Instructors generate realistic scenarios geared to trigger decisions in various training events (classroom, trainer and in-flight)

***Increase versatility in thinking***

# Aviator SA/Decision Skills Training

- Applies across spectrum of training and operations
- Captures, reinforces & extends thinking skills
- Builds on experience base
  - Practice making decisions in context
  - Develop/enhance pattern recognition skills (SA)
- Facilitates crew self-evaluation
- Maximizes instructor/student interaction

***Optimize Decision Making Under Pressure***

# Integrated CRM Example

## *Hydraulic System*

### SCENARIO 1

You are conducting a routine mission in W-291 working area, and the weather at NZY is 2500 OVC with 5 miles of visibility and light rain. You see these indications.



1. Problem
2. Actions to take
3. Critical cues

HYD 14



OPTIONS

\* CRM = Crew Resource Management

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# In Summary

- CRM training implementation plan integrating:

- **CAPAS hardware, software and analysis**

- Leverage advances in IT to scientifically and systematically improve training and readiness

- **Flight Instructor and decision skills training**

- Increase depth and broaden experience level

- **Curriculum development training and tools**

- Better defines MOP and MOE for more relevant training, assessment, and feedback

***CRM/ORM Becomes a Practice ...Not a Program***

\* CRM = Crew Resource Management

# Points of Contact

- Naval Air Board Human Factors QMB,  
Training Improvements Working Group

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